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United States Patent [19][11] **Patent Number:** **5,783,083****Henshaw et al.**[45] **Date of Patent:** ***Jul. 21, 1998**

[54] **VERTICAL CYLINDRICAL SKEIN OF
HOLLOW FIBER MEMBRANES AND
METHOD OF MAINTAINING CLEAN FIBER
SURFACES**

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[75] **Inventors:** Wayne Jerald Henshaw, Burlington;
Mailvaganam Mahendran, Hamilton;
Henry Behmann, Puslinch, all of
Canada

Primary Examiner—Ana Fortuna
Attorney, Agent, or Firm—Alfred D. Lobo

[73] **Assignee:** Zenon Environmental Inc., Ontario,
Canada

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beyond the expiration date of Pat. No.
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Related U.S. Application Data

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Pat. No. 5,639,373.

[51] **Int. Cl.⁶** **B01D 61/00**

[52] **U.S. Cl.** **210/636; 210/500.23; 210/650;
210/321.69; 210/356; 210/321.8; 210/321.89;
210/257.2**

[58] **Field of Search** **210/636, 321.69,
210/321.8, 321.89, 257.2, 650, 500.23,
641, 356**

[56] **References Cited**

U.S. PATENT DOCUMENTS

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[57] ABSTRACT

A gas-scrubbed vertical cylindrical skein of "fibers" has their opposed terminal portions held in headers unconfined in a modular shell, and aerated with a cleansing gas supplied by a gas-distribution means which produces a mass of bubbles serving the function of a scrub-brush for the outer surfaces of the fibers. The skein is surprisingly effective with relatively little cleansing gas, the specific flux through the membranes reaching an essentially constant relatively high value because the vertical deployment of fibers allows bubbles to rise upwards along the outer surfaces of the fibers. The effectiveness is critically dependent upon the length of each fiber in the skein. That length is in the range from at least 0.1% more than the fixed distance between opposed faces of the skein's headers, but less than 5% greater than the fixed distance. Lack of tension allows the fibers to sway in bubbles flowing along their outer surfaces making them surprisingly resistant to being fouled by build-up of deposits of inanimate particles or microorganisms in the substrate. For use in a large reservoir, a bank of skeins is used with a gas distributor means which has fibers preferably >0.5 meter long, which together provide a surface area >10 m². The terminal end portions of fibers in each header are kept free from fiber-to-fiber contact with a novel method of forming a header.

14 Claims, 13 Drawing Sheets

